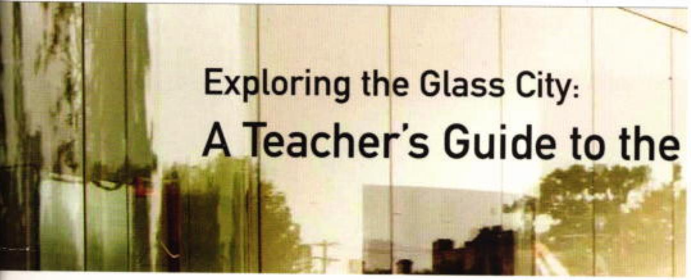
Toledo Museum of Art



Exploring the Glass City:

A Teacher's Guide to the Glass Pavilion

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Welcome to the Glass Pavilion

Housing one of the world's finest international glass collections, the Glass Pavilion at the Toledo Museum of Art is itself an international marvel. The implementation of a new process in glass design and fabrication, the talents of SANAA, the building's internationally recognized architectural firm, and a postmodern design built on the belief of social transparency, make the building an architectural and social masterwork.

The Glass Pavilion's primary purpose is to present the Museum's glass collection within the context of all the visual arts. The building is unique in that it unites the glass collection, related works of art in other media, and opportunities to explore glassmaking. In addition to galleries for the display of art, the Pavilion contains a glassmaking facility consisting of two hot shops and studios for lampworking, casting, molding, and flat and cold-working techniques. The Pavilion also includes spaces for loading, storage, administration, conservation and photography.

Exploring the Glass City: A Teacher's Guide to the Glass Pavilion

The activities in this guide are designed to be used prior to your visit to enhance learning that will take place at the Museum, or after you return to the classroom. Each activity is aligned to the Ohio Academic Content Standards.

Tips on using this guide:

- Review the guide and Web activities. The fictional stories are designed be read out loud to your class.
- Based on your learning goals, determine which components you and your students will complete before or after your visit. Create customized lessons by adding or deleting activities, based on the content standards you would like to meet.
- Use this guide in combination with notebooks or journals. Encourage students to observe, question, and record notes prior to and during your Glass Pavilion visit.
- Take the Glass Pavilion experience back to class by completing additional guide or Web activities.
- Utilize the Resource Center for Educators at the Toledo Museum of Art. The Exploring Glass Discovery Box will help you prepare for your visit.

Your visit to the Glass Pavilion

Thank you for choosing the Toledo Museum of Art Glass Pavilion for your class field trip! Your Museum experience will be more fun from the very start if you remember to:

- Have each child wear a nametag with her/his first name in large print.
- Divide your class into groups of 15 students, and assign one adult chaperone to each group.
- Advise the Docent who will be giving your tour, when he/she calls to confirm the tour, of the related curriculum areas you have covered with your students prior to your visit.
- Share with your Docent any accommodations necessary for special needs children you might have.
- Arrive on time.

For more information go to:
www.toledomuseum.org/pdf/Glass_Pavilion_Teachers_Guide.pdf

Talkin' Glass...Words to Know

What Is Glass, Anyway?

Glass is the oldest man-made material. Most glass is a mixture of silica (from sand or sandstone), an alkali to lower the melting point, and lime to act as a stabilizer. The mixture, when melted, fuses together. It can be poured or blown into a shape and allowed to cool slowly. The glass then becomes rigid without crystallizing.

Something to Think About...

Is glass a liquid or a solid? When glass is cool it is hard but also breakable, because it doesn't have the molecular structure of a solid. When it is hot, it is a liquid easily poured, blown, or molded. Glass is called a "supercooled liquid." What does that mean? Do you know of any other supercooled liquids?

GLOSSARY

Anneal
to slowly cool a completed object in a secondary or separate part of the glass furnace. This important part of the glassmaking process allows a hot glass object to cool slowly. If allowed to cool too quickly, the glass may be highly strained by the time it reaches room temperature and may break.

Batch
the mixture of raw materials, often silica, soda, or potash, and lime.

Blowpipe
an iron or steel tube, usually about five feet long, for blowing glass. Blowpipes have a mouthpiece at one end and are usually fitted at the other end with a metal ring that helps to retain a gather.

Casting
the generic name for a wide variety of techniques used to form or pour glass into a mold.

Cristallo
(first used in Venice in the 14th century) a type of glass that resembles colorless rock crystal. Most Venetian cristallo, however, has a gray or brownish tint.

Cutting
grinding any pattern into the glass by using a consistent speed on a rotating wheel coated with cloth, diamond dust, or another abrasive.

Diffraction
when light passes sharp edges or goes through narrow slits, the rays are deflected and produce fringes of light and dark bands.

Fuse(ing)
heating cut glass in a kiln to melt pieces together.

Furnace
an enclosed structure for the production and application of heat. In glassmaking, furnaces are used for melting the batch, maintaining pots of glass in a molten state, and reheating partly formed objects at the glory hole.

Gaffer
head of a glassblowing team.

Glory Hole
the opening in the oven where glassblowers reheat the glass when it has cooled.

Grisaille (pronounced "griz-EYE")
painting technique using gray, monotone colors.

Hot Shop
a studio containing furnaces for working with molten glass.

Iridescence
the visual property of something having a milky brightness.

Interference
a hindrance or obstruction.

Lead
a soft metal element shaped around each piece of glass in a stained glass window.

Punty (Pontil)
a long metal rod used to gather molten glass, which can then be used in various ways for the decoration or finishing of an object.

Rose Window
a circular window with spoke-like or rose-like tracery.

Sandblasting
a method used to remove layers of glass. A cloudy, dull finish will result with every layer removed.

Shard
glass fragments, usually colored, which would be rolled or melted into a working piece to add color or texture.

Slumping
using a kiln to soften a piece of glass in order to get it to take the shape of a mold.

Tracery
stonework surrounding the overall shape of a window.

Viscosity
a degree of being sticky, semifluid.

From the Corning Museum of Glass, Glass Vocabulary at www.cmog.org

OHIO ACADEMIC CONTENT STANDARDS

Visual Arts
Grades 6-8
Historical, Cultural, and Social Contexts

Visual Arts
Grades 5-8
Creative Expression and Communication

Social Studies
Grade 7
History, Early Civilizations

Social Studies
Grade 4
Skills and Methods, Thinking and Observing

Science
Grades 4-6
Nature of Matter, Nature of Energy

WHAT'S THE ACTIVITY?

Students will experience the process used in ancient glass vessel manufacture.

Core-Formed Polymer Clay Vessel

MATERIALS

Clumping-style cat litter
Play sand
Water
Polymer clay, such as "Sculpey" in various colors
Pencils with new erasers
Round toothpicks
Styrofoam plates
Pyrex baking dish

DIRECTIONS

1. Forming the Core:
   Explain to students that ancient Egyptians formed cores of sand, clay, or animal dung. Mix equal parts of cat litter and sand, adding water until a clay-like texture is achieved. Distribute 1 1/2 tablespoons of the mixture to each student on a foam plate on which their name is written. Have students form a cylinder measuring 1 1/2 to 2 inches in height and up to 1 inch in diameter. Avoid forms that taper towards the top. Allow the core forms to dry for at least 24 hours.

2. Covering the Core:
   Roll thin "worms" of polymer clay and wind them gently around the core. Alternate colors to create stripes. Thickness should be consistent and not exceed 1/4" inch. Gently pat the surface until it is smooth and the ridges disappear. Attach a flat base, slightly larger than the core. A fluted lip can also be added at the top if desired.

3. Pull the edge of a clean pencil eraser lightly down the length of the vessel at 1/4 to 1/2 inch intervals to create characteristic feathery scallops.

4. Baking and Core Removal:
   Place completed pieces on a Pyrex surface and bake in a kitchen oven at 275° F for 15 to 25 minutes until hardened. When cool, students can scrape the core out with heavy, round toothpicks or skewers. Residue will rinse out.

Meti

Egypt, 1250 b.c.

The sun was blazing on Meti's back as he scraped the core of sand and clay from a tiny bottle. Daydreaming, Meti barely noticed the beauty of the vessel, a rich, deep blue with a feathery, white pattern in bands around it.

A familiar chatter brought Meti quickly to full attention. Lots of boys kept monkeys as pets, but Meti's was far more mischievous and had just made a forbidden arrival at the glassworks. The chase was on, with the agile little monkey leading the way to the outer area of the yard, where large ceramic pots called crucibles heated the silica-sand, lime, and soda to melting. The men working around the fires did not like disruption as they poured blocks of the raw glass. They shouted and shook fists as Meti and the gleeful monkey wove in and out of the fires.

The monkey's next stop was the area where the bottles and other objects were formed. He scurried onto the back of Mhotep, the old man who formed the clay and sand cores that Meti later scraped out. Mhotep smiled, firmly handed the little monkey to Meti, and continued with his work. He covered the bottle-shaped core with cloth and attached it to a metal rod. Meti decided the safest route out with his pet was forward through the main yard. Workmen paid no attention to the pair as they dipped Mhotep's core forms into small crucibles in which raw glass had been reheated. The metal rod was spun to evenly distribute the glass. Colorful glass rods were wound around the red-hot forms, creating stripes. Next, the craftsmen pulled sharp tools through the stripes to create feathery patterns. As Meti watched in fascination, the strong little monkey struggled free and ran past the polishers, cooling ovens, and fire tenders towards the glassworks entrance.

WHAT'S THE CONNECTION?

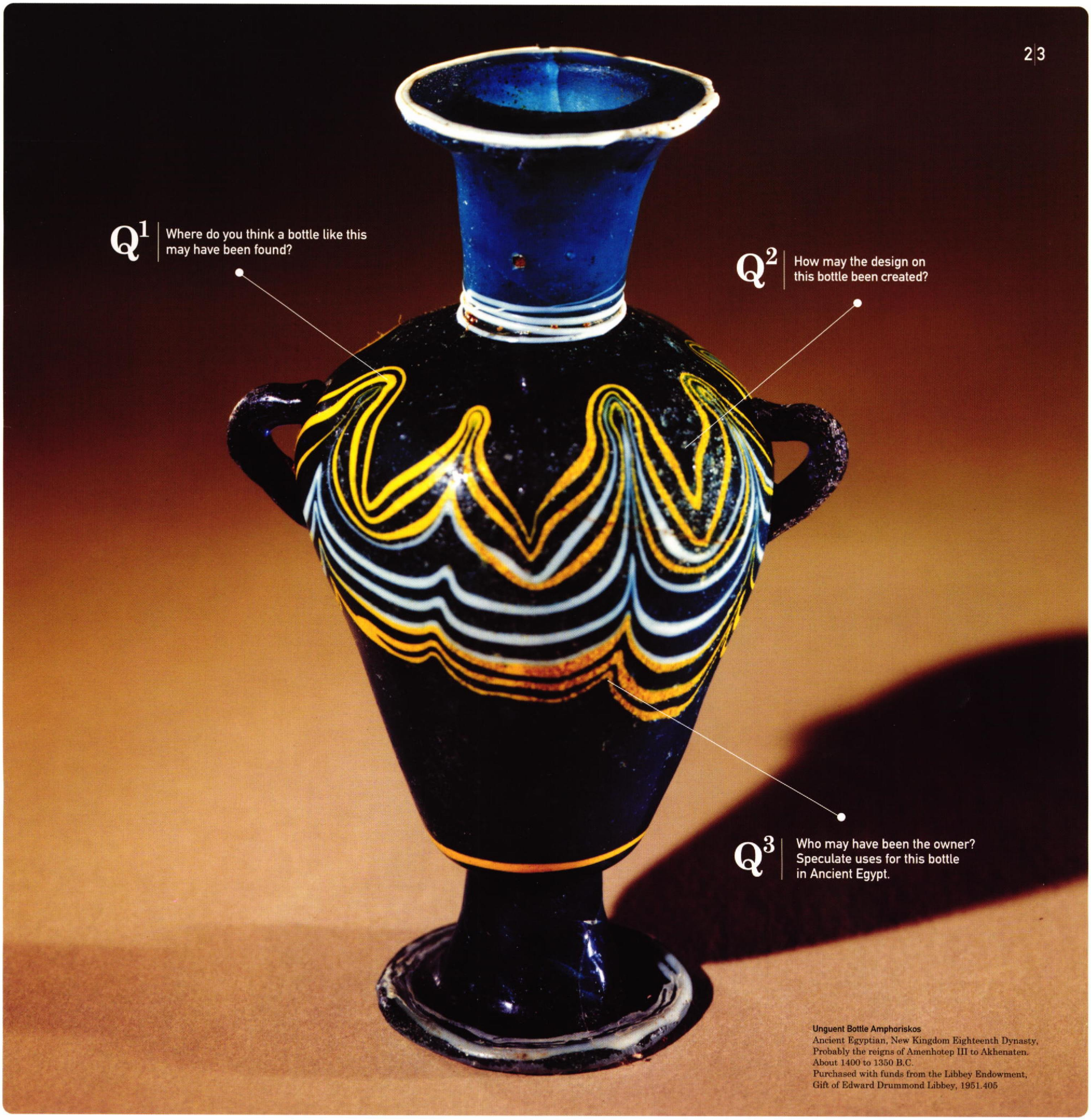
With students review the terms iridescence, interference, and diffraction and observe examples of each.

Much ancient glass has developed a patina of iridescence through weathering. Show examples of iridescence: peacock feather, opal gemstone, butterfly wing, compact disc, soap bubbles.

Use magnification to view the objects to show their many tiny, irregular surfaces, which "interfere" with light rays to create a rainbow effect.

Have students view various objects, including an electric light, through a diffraction grating. The fine lines of the diffraction grating will break light into its spectral colors. This is the same phenomenon that occurs when light is diffracted off the irregular surfaces of the iridescent objects.

As Meti watched in complete dismay, his pet darted right between Meti's father and an important official of their great Pharaoh, Ramses II. Spotting Meti, his frowning father motioned him over. The visitor smiled broadly. "As a boy, I had such a pet, and it often led me into much mischief!" he said. "We are choosing fine objects of glass which I will present to a far away leader. What do you have in your hand?" At the question, Meti realized that he still held firmly onto the blue and white bottle. For the first time he saw how delicate and beautiful it was. He handed the bottle to the official and its journey through far away places and thousands of years began.



Q¹ Where do you think a bottle like this may have been found?

Q² How may the design on this bottle been created?

Q³ Who may have been the owner? Speculate uses for this bottle in Ancient Egypt.

Unguent Bottle Amphoriskos
Ancient Egyptian, New Kingdom Eighteenth Dynasty,
Probably the reigns of Amenhotep III to Akhenaten.
About 1400 to 1350 B.C.
Purchased with funds from the Libbey Endowment,
Gift of Edward Drummond Libbey, 1951.405

WHAT'S THE HISTORY

Researchers continue to refine theories about the discovery and early manufacture of glass. One scenario involves ancient sailors cooking on the beach. Perhaps their fire heated sand (silica) in close proximity to their cargo of natron bricks, thus forming a liquid that cooled to glass. Faience, an early form of glass, was produced in Mesopotamia and Egypt as early as 3500 b.c. It was used as a pottery glaze and to cast small objects, beads, and inlays.

Earliest glass produced in Egypt was exclusively for the Pharaoh's court. Archaeologists have discovered workshops close to royal palaces. The first hollow glass vessels appeared around 1500 b.c., during the New Kingdom reign of Tuthmosis I. These small bottles, vases, and bowls were created using the core-formed method described in the story.

Ancient glass often has an iridescent surface patina. Modern glass artists strive to achieve this beautiful "rainbow" effect by a variety of techniques. On ancient glass, however, the effect is the result of the weathering process. Multiple levels etched into the surface of the glass reflect light at various angles, creating an optical effect known as interference.

Q1 ANSWER

This vessel was part of the grave goods buried with a member of ancient Egyptian nobility nearly 3,500 years ago. These bottles were believed to magically provide the tomb owner with their fragrant contents in death and in the after life.

Q2 ANSWER

After the body of the vessel was completed the trailed decoration in a contrasting color could be wound onto the surface. The feathery pattern was created by dragging a sharp point up and down the piece.

Q3 ANSWER

A wealthy person. Probably used to hold scented liquid that may have been applied to self, statue of the gods or the body of deceased.

OHIO ACADEMIC CONTENT STANDARDS

Mathematics
Grades 3–4
Fractions, Circles, Symmetry

Social Studies
Grades 3–5
History, Peoples in Societies, Social Studies Skills and Methods

Visual Arts
Grades 4–8
Historical, Cultural and Social Contexts

Visit our Web site for additional resources and SUPERCOOL!, a science lesson on the nature of matter.
www.toledomuseum.org/pdf/Glass_Pavilion_Teachers_Guide.pdf

WHAT'S THE ACTIVITY?

Students will explore the concepts of symmetry, fractions, and circles to create a colorful transparent sun catcher in the style of cathedral rose window.

Radial Design Rose Window Sun Catcher

MATERIALS

- One Sheet 8 1/2" X 11" overhead transparency film for each student
- One sheet white copy paper for each student
- Fine point permanent black markers
- Compass or circle template
- Glass paint
- Small paintbrushes
- Aluminum foil or Styrofoam plate for "palette"

DIRECTIONS

1. Use circle template or compass to draw a 6" circle on paper. Cut out circle.
2. Fold the circle in half, then quarters, then eighths. A lesson on using a compass to measure angles can be done here also.
3. Unfold the circle and draw design on one slice of the "pie." Examples of rose windows will encourage students to use motifs from nature, as well as personal symbols. Encourage students to have their design touch the edge of the pie slice in several places.
4. Place the transparency film over the paper design, taping with masking tape if needed to prevent slipping. Trace the design onto the film with permanent marker, rotating and carefully aligning the edges for each of the eight "slices."
5. Pour a small amount of glass paint onto the palette. Work with one color at a time, as the paint dries quickly. "Flow" the paint onto the film to prevent brush marks.
6. When dry, cut the circle from the film. The painted side of the sun catcher will adhere to any glass surface.

Ysabel

France, 1250 b.c.

My name is Ysabel, and I live in Paris, France. Today is the most exciting day! I am going to visit my father's friend Luc, the glassmaker. I am very lucky, because most of my friends must stay home and help with household chores. Not me! Today I am off to town. Yesterday I heard Mama telling Papa that I get into too much mischief while he is away working on the cathedral. She does not know what to do with me! Papa says he cannot take me with him, because the cathedral is no place for an eight-year-old girl. After that, he spoke to Luc, who said I could spend the day with him—like an apprentice. Papa knows how I dream of becoming an architect someday, but his work on the cathedral in Chartres is so far away that I cannot go with him. Someday when I am older, I will have the chance to see this magnificent building.

Papa says it may take as many as 50 more years to complete. By that time, the windows like Luc is making will be in place, and everyone will see their beauty. Before my trip, Mama tells me that Luc is a master of his trade; she says that he will melt potash (wood ash) and sand at a very high temperature to make the glass. I must of course be on my very best behavior, since it can be very dangerous to be so near the fire. After the mixture is melted into a liquid, Luc will gather it on a blowpipe and turn it until it forms a cylinder-like shape. He will cut the cylinder and let it cool. After reheating, the molten glass will be flattened into a sheet. Mama says I will be amazed when the iron oxides are added to make the different colors. These sheets of glass will be used to fill in the "cartoon" or sketch that an artist has created. After being cut into shapes, the pieces will be fused together with lead. Mama says that when the windows are in the cathedral, they will tell stories to those who look at them, especially those who cannot read.

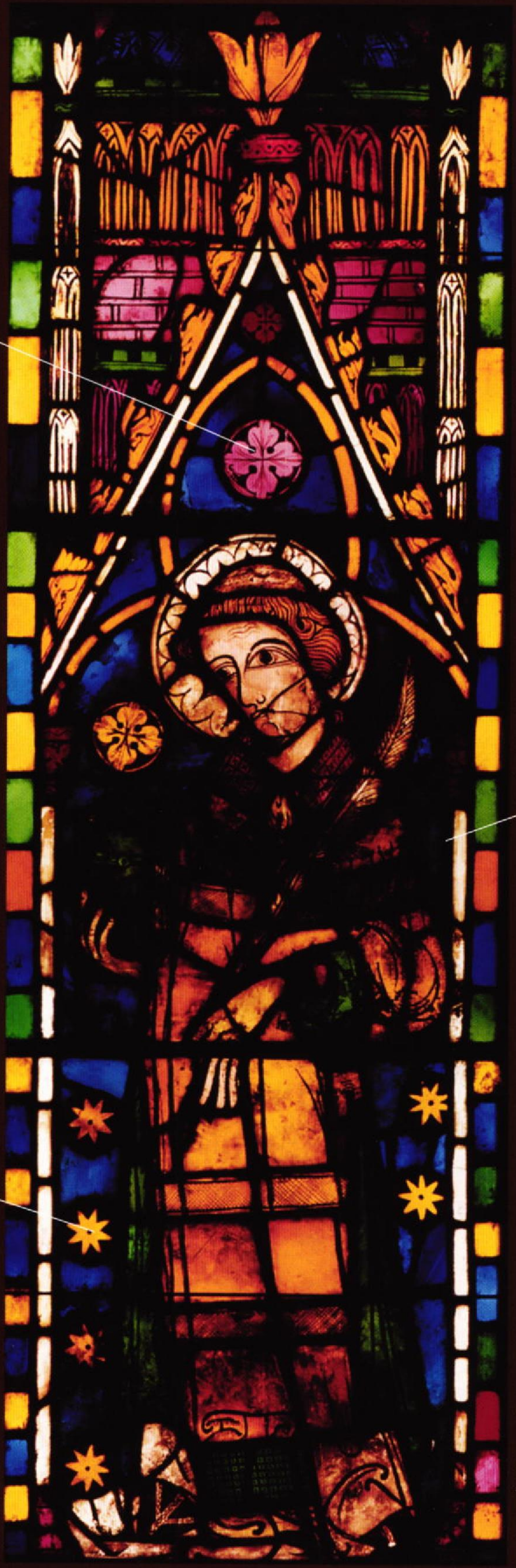
I cannot wait to visit Luc and someday see his windows let light and mystery into the great Cathedral of Chartres.

WHAT'S THE CONNECTION?

Students will simulate glass making with a sugar mixture and have the opportunity to observe that heat and energy are required to make glass. Since ancient times, glass has been manufactured by heating a sand/lime/soda mixture and slowly cooling it.

Have students gather the following: 2 cups sugar, 1/3 cup light corn syrup, 1/3 cup water, 2 tsp. vinegar, nonstick cooking spray, an electric frying pan or hot plate, a shallow cookie sheet, a small piece of glass, and a candy thermometer.

Combine all ingredients by stirring vigorously. Cook until the thermometer reaches 300 F. Carefully pour the mixture onto the sheet of glass that has been coated lightly with non-stick spray. If the glass is small enough, set it inside a cookie sheet to prevent run over. Allow it to cool about 15 minutes. Hold up the two sheets of glass (real and newly made) so students can see through them simulating stained glass. Consider adding food color to the mixture to emulate the colors seen in stained glass.



Q1 Stained glass told stories to those unable to read. What story would you tell if you had to do so with pictures?

Q2 Imagine seeing this piece for the first time, what are some words you would use to describe the color?

Q3 As a class, talk about where you might see stained glass.

Saint
14th century, possibly France
Stained glass
Purchased with funds from the Libbey Endowment,
Gift of Edward Drummond Libbey, 1945.22

WHAT'S THE HISTORY

Stained glass making was popular during Medieval times dating back as early as the 900s. These windows, which were generally religious in nature, told stories of saints and biblical characters, and were a teaching tool for those who were uneducated and unable to read.

Construction of Chartres Cathedral began in 1145; the stained glass windows of the building were so sturdy they survived a fire in 1194 that destroyed much of the structure. Chartres was rebuilt beginning in 1205.

Light passing through the colored glass makes the windows truly amazing. Color was created when metal oxides were added to the molten glass or when colored material was placed between two sheets of glass. The glass is then melted and cooled again before being cut into pieces. Windows were often designed in geometric shapes such as circles, squares, and quatrefoils (4 leaf shapes). After the glass was cut to fit the patterns, the design of the individual pieces were fused together with lead. Often, details painted in grisaille were used to define faces or other features.

Note: this work of art is not on display in the Glass Pavilion. To view this piece, please visit the Toledo Museum of Art Cloister Gallery.

OHIO ACADEMIC CONTENT STANDARDS

Visual Arts
Grades 6-8
Historical, Cultural, and Social Contexts

Visual Arts
Grades 5-8
Creative Expression and Communication

Social Studies
Grade 7
History, Feudalism, and Traditions, the First Global Age

Social Studies
Grade 6, 7
Economics, Markets, Thinking and Organizing, Scarcity and Resource Allocation

Social Studies
Grade 7
Geography, Movement

WHAT'S THE ACTIVITY?

Students will design and create a collage to be viewed through the beauty of glass.

Glass Collage

MATERIALS

Smooth, clear glass plates
Gift wrap, printed and solid tissue paper, and magazines such as Birds and Blooms or National Geographic
Scissors
Foam paint brushes
Decoupage sealer, such as Mod Podge
Wax paper
Disposable cups for sealer

DIRECTIONS

1. Remove stickers from the plates and clean with glass cleaner.
2. Cover each work area with a piece of wax paper. Tape to secure, if necessary.
3. Cut images from the various printed papers to create the design. Discuss with students the elements of a good composition and encourage detailed, careful cutting and creative overlapping of images. Arrange the composition on the top of the plate, working from the background up. A circle of colored tissue paper, the diameter of the plate, often makes an attractive background, uniting the separate images.
4. Slide the paper design onto the work surface, and turn the plate over.
5. Using the foam brush, apply sealer to affix the paper images to the back of the plate. Place images so that they will be seen when viewing the front of the plate. Reapply sealer as needed for overlapping layers. Apply a final coat of sealer over the entire surface.
6. Allow plates to dry in place overnight. When dry, excess paper may be trimmed from the edges.

*The plates may be hand washed, but not immersed.

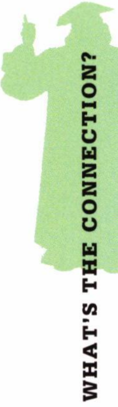
Antonio

Venice, 1530

Antonio raced through the streets of Murano with a letter of instruction from his father to the furnace tenders. As he rounded the corner, he could see the great Venetian merchant ships. Grandfather's grandfather had seen such ships bring captives with the secrets of Islamic glassmaking to Venice after Constantinople fell in the year 1204.

Antonio dreamed of sailing on one of the great ships, but that would never be. In order to protect the secrets of the finest glass in the world, the glass craftsmen and their families were forbidden to travel from Venice. Even Antonio knew some of those secrets—special pure pebbles of silica from the Ticino River, potash created by burning and purifying a special plant from the sea, and a touch of manganese. These ingredients created the famous "cristallo," glass so clear and pure that it rivaled rock crystal and was prized by royalty and the wealthy worldwide.

Arriving at the glassworks, Antonio found the "men of the night" as people called them, tending the three-tiered wood furnace. All through the night they fed the huge structure, preparing the glass that his father and the other glass blowers would craft into valuable Venetian glass. The bottom layer of the furnace held the burning wood, the middle layer held molten glass, and the top layer slowly cooled the finished pieces.



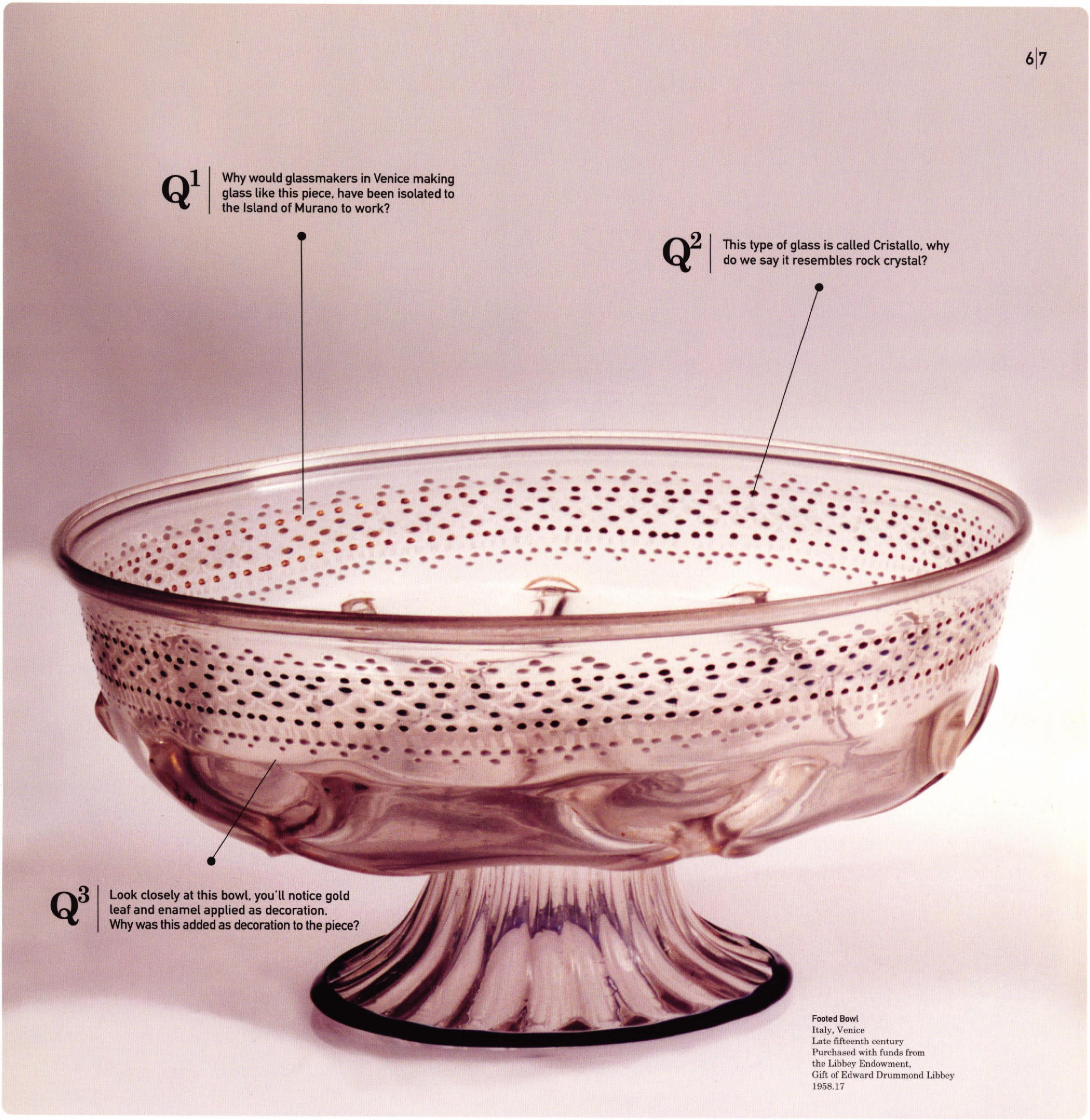
WHAT'S THE CONNECTION?

Students will simulate how glass blowers work to keep glass on a blowpipe by using the same method with honey on a chopstick.

Have students dip a chopstick into a small cup of room temperature honey. Ask students to try to keep the largest gob of honey possible (by rotating the stick) on the tip as they pull it out of the cup. Explain that they are simulating how glass blowers work with gravity to keep the molten glass at the end of their blowpipe.

Antonio delivered his letter and turned to leave, thinking of merchant ships and far away places. He wondered if he and his family were really just prisoners of this island—making things that would travel to places he never could.

Suddenly, light glinted from a row of glass from the cooling ovens—such beauty! He marveled at a pitcher of pure "cristallo" decorated with intricate spirals of milky white glass, a goblet with a serpent-shaped stem, and a bowl enameled with flowers. This was the most beautiful glass in the world—glass made by generations of Antonio's family, making the Republic of Venice wealthy and famous. Someday, Antonio himself would turn pebbles and potash into sparkling beauty.



Q^1 Why would glassmakers in Venice making glass like this piece, have been isolated to the Island of Murano to work?

Q^2 This type of glass is called Cristallo, why do we say it resembles rock crystal?

Q^3 Look closely at this bowl, you'll notice gold leaf and enamel applied as decoration. Why was this added as decoration to the piece?

Footed Bowl
Italy, Venice
Late fifteenth century
Purchased with funds from
the Libbey Endowment,
Gift of Edward Drummond Libbey
1958.17

WHAT'S THE HISTORY

The years 1200 to 1527 brought many exciting changes and advancements to the city of Venice including trade, the glassmakers' guild, and the dominance of this type of glass. With your students review these events by using the glass timeline and answer these questions:

Discuss the effects of trade and conquest on the development of Venetian glassmaking.

Map trade routes of Venetian ships to Egypt, Syria, Turkey, and Lebanon.

Discuss the evolution of the artist from a member of a tradesmen's guild in the Middle Ages to the creative individual of today.

Q1 ANSWER
Glassmakers were moved to the island to ensure fire safety and to enforce government control of what was produced.

Q2 ANSWER
Cristallo is very clear glass with a slight grey or brownish tint. Such glass could be molded into intricate shapes such as this footed bowl.

Q3 ANSWER
The bowl was probably used by a wealthy patron. The addition of gold leaf and enamel would have given it a rich appearance.

OHIO ACADEMIC CONTENT STANDARDS

Social Studies
Grades: 3-5
History, Geography, Peoples in Societies, Economics, Social Studies Skills and Methods

Grades: 6-8
History, Geography, Economics
Science

Grades: 3-5
Scientific Inquiry
Physical Science
Visual Arts

Grades: 4-8
Historical, Cultural, and Social Contexts

WHAT'S THE ACTIVITY?

After studying a glass object, students will speculate about the history of the piece by uncovering clues about its production.

Become a History Detective!

MATERIALS

Read Historical Artifacts handout available from www.toledomuseum.org
Pencil or pen
One glass bottle/object for each group
Note: glass bottles can be collected or are a part of the Glass Discovery Box available from TMA Resource Center for Educators.

DIRECTIONS

1. Place students in small groups of 4 or 5.
2. Ask students what they know about glass, how it is made, and what objects they use each day that are made of glass. Write those answers on the blackboard.
3. Give each group a copy of the handout Reading Historical Artifacts.
4. Give each group a glass bottle.
5. Ask students to pass their artifact around the group for examination. Students should discover as much as possible about the object by looking and touching.
6. Have student groups answer the questions on the handout and share their findings with the entire class.
7. Next, have students formulate at least three additional questions about the object for further exploration.
8. Allow each group time to complete further research using the Internet or the library.
9. Have each group share with the class a poster they've created to explain what they researched and discovered.

For another fun activity go to:
www.toledomuseum.org/pdf/Glass_Pavilion_Teachers_Guide.pdf

Edward Drummond Libbey

Chelsea, Massachusetts, 1872
Toledo, Ohio, 1888

As a young man, Edward Drummond Libbey stood on the front stoop of the New England Glass company, broom in hand. His old friends and classmates passed by, amused at his choice to work with his father in the glass business. After all, a boy from one of the oldest and most well respected families of Boston was expected to attend Harvard University, not to work as a clerk in a factory.

When Edward Libbey entered the glass business with his father, William Langdon Libbey, in 1874, almost half of the workforce was made up of boys in their teens or younger. At the time, there were no child labor laws, and boys were hired for the lowest paying jobs, which were hot, dirty, and difficult.

At the New England Glass Company these positions were "take-out boys," "snapper-ups," and "carry-in boys." These jobs meant carrying the blown glass from the skilled glassblowers to the finishers, and then from the finishers to the cooling ovens, where the glass would harden. In the early years, Edward Libbey learned about all aspects of the glassmaking industry, listening and absorbing all he saw and heard.

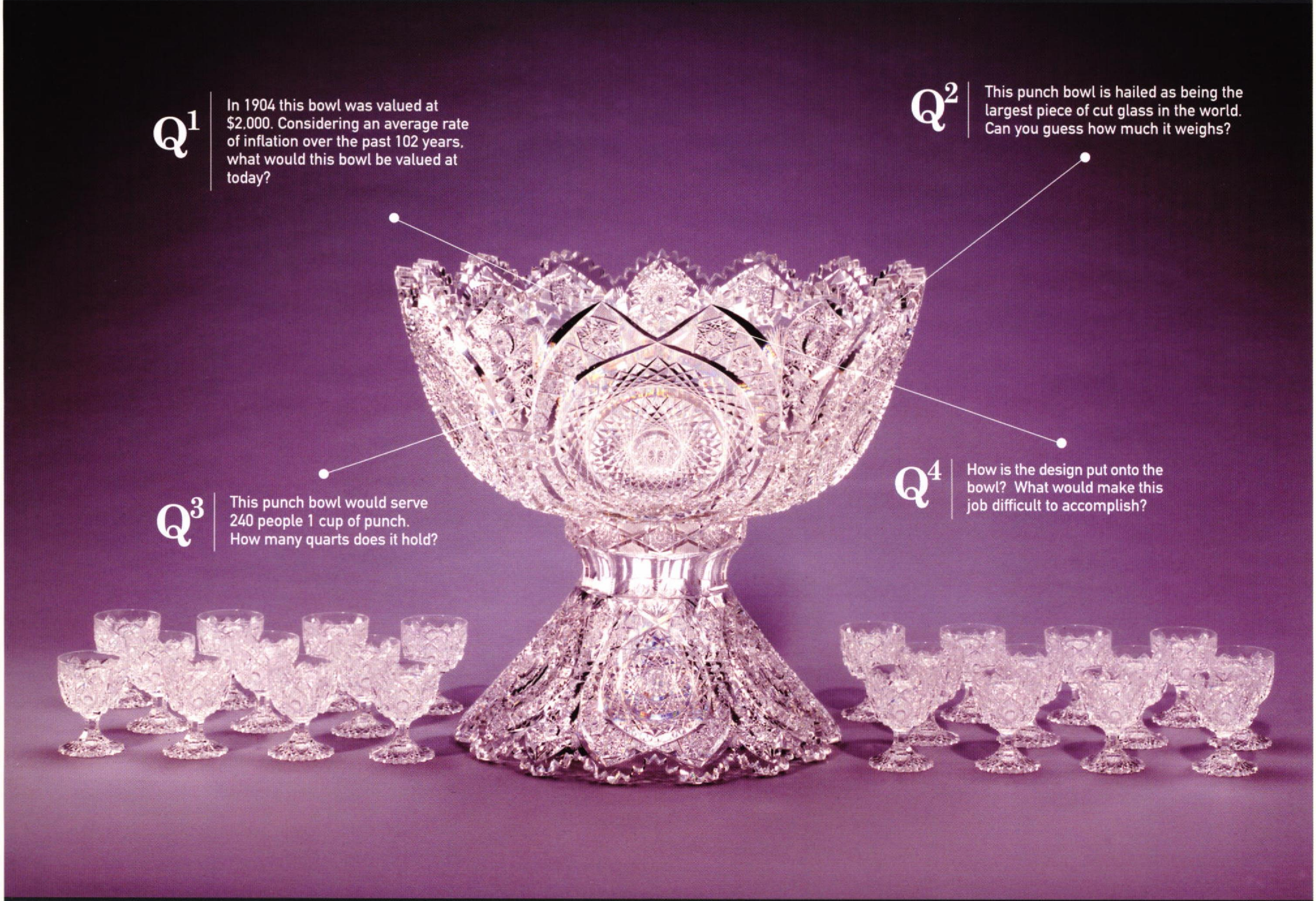
William Libbey, Edward's father, wanted his son to go to college, as was expected of all "proper Bostonians." By exposing him at a young age to the worst jobs in the factory, his father tried to convince him to pursue a college education. Succumbing to his father's wishes, Edward Libbey attended college for two years. Afterwards, he returned to work with his father and eventually inherited the New England Glass Company in 1883. In 1888 he moved the company to Toledo, Ohio, and changed its name to Libbey Glass Company. Under Edward Drummond Libbey's leadership, it became successful and famous around the world.

WHAT'S THE CONNECTION?

Prominent Americans who collected art, like Edward Drummond Libbey, helped to open museums as a way to give back to the commu-nities that made them wealthy. Although he never considered himself an artist, glass made in his factory is now on display at the Toledo Museum of Art, the museum he helped to create.

In 1888 Edward Drummond Libbey moved his glass factory to Toledo, Ohio because of economics and abundant natural resources. Ask students to look at a blank map of Ohio and answer the following questions:

- What are natural resources?
- What natural resources, available in Ohio, did Libbey need to make glass?
- On the blank map, draw small pictures of these natural resources and where they were located.
- What happened to the same natural resources in New England? How about later to those natural resources in Ohio?
- What other economic factors helped Libbey decide on Toledo as the new home of his glass factory? Hint: The mayor at the time really wanted Libbey Glass to make its home.



Q^1 In 1904 this bowl was valued at $2,000. Considering an average rate of inflation over the past 102 years, what would this bowl be valued at today?

Q^2 This punch bowl is hailed as being the largest piece of cut glass in the world. Can you guess how much it weighs?

Q^3 This punch bowl would serve 240 people 1 cup of punch. How many quarts does it hold?

Q^4 How is the design put onto the bowl? What would make this job difficult to accomplish?

Punch Bowl and Cups, 1903-04
Libbey Glass Company,
Toledo, Ohio
Gift of Libbey Glass Company,
Division of Owens-Illinois Glass Company,
1946.2

WHAT'S THE HISTORY

1818
The New England Glass Company is founded in Chelsea, Massachusetts

1880
William and Edward become partners and change the company name to W.L. Libbey and Son Proprietors, New England Glass Company

1888
E. D. Libbey moves the company and employees to Toledo, Ohio

1892
Name changes to Libbey Glass Company

1903
Michael J. Owens, supervisor at Libbey Glass, patents the Bottle Blowing Machine that revolutionizes the glass industry.

Q1 ANSWER
$41, 047.14
This question is for mathmatical purposes only and does not reflect the art market value of the work of art.

Q2 ANSWER
134 pounds

Q3 ANSWER
60 quarts. 1 Quart = 4 cups

Q4 ANSWER
Cutting. One difficulty would be holding the bowl at 134 pounds.

OHIO ACADEMIC CONTENT STANDARDS

Science
Grades 6-8
Physical Science, Scientific Inquiry, Scientific Ways of Knowing

Visual Arts
Grades 5-8
Historical, Cultural and Social Contexts

WHAT'S THE ACTIVITY?

By creating studio-like glass, students will explore the glassmaking process much like Dominick Labino used.

Create Your Own Studio "Glass"

MATERIALS

- Dura-Lar Clear
- Sharpie Oil-based Paint Markers: Gold, Silver, Black
- Transparent glass paint in assorted colors
- Small paintbrushes
- Scissors
- Heavy rubber gloves
- Electric skillet
- Water

Notes:
For rigid, glass-like pieces, use .020" thick extra-heavy 18" X 24" single sheets of Dura-Lar (55506-1109). For slightly flexible, more economical pieces, use .010" thick heavy 25" X 40" sheets (55506-1100). One 18" X 24" sheet makes six works of art.

Materials available from www.dickblick.com

DIRECTIONS

1. Use strong scissors, craft knife, or paper cutter to cut Dura-Lar into 6" X 8" pieces—2 pieces per student.
2. Ask students to predict what might happen to the material when it is placed in the heated water. Have students write the prediction in a science journal where they can also record observations as they create their work of art.
3. Heat water in skillet to 150°–175°F. Water should be just warm enough to soften material enough to be manipulated. Test a scrap to make sure it's not too hot before students begin.
   Note: Excessively high temperature will cause Dura-Lar to melt and release fumes.
4. Take one piece of Dura-Lar, and cut it into a free-form oval with multiple and random scalloped edges. Cut 2 smaller shapes out of the second piece. Save scraps.
5. Practice. Put on rubber gloves, and pick up a scrap of Dura-Lar with tongs, and place in hot water. After allowing it to heat, begin to shape it. Allow students a few minutes to work with the material, experimenting with ways to bend and form while holding one area in the water. Note the short window of time to work with the material before it cools down and becomes rigid.
6. Beginning with the smallest piece of material, students should begin to shape their sculpture by forming one part at a time. Dura-Lar cools very quickly, but an area that has been formed can be reheated and molded again. There will be a tendency to overwork the material; remind students to keep the shape looking like a bowl.
7. Continue with the two larger pieces, testing each one in-between to make sure the forms will "nest" together.
8. Add color on the back surface of each piece with glass paint. It is not necessary to apply an even coat of paint as an uneven thickness will give the look of glass. Blend colors while still wet.
9. Once dry, carefully use a Sharpie marker to apply a thin, contrasting line of color the edge of each piece.
10. Place on a light table, attach to a window, or hang beneath ceiling lights to view.

Activity from www.dickblick.com

The Studio Glass Movement

Julie Delph
Toledo, Ohio, 1968

One Saturday I was outside playing with my Etch-A-Sketch when Dad said, "Put down your toys Julie, we're going someplace special." We got in the car and drove down Rt. 24 to Grand Rapids, Ohio. After turning onto a gravel driveway we parked the car and made our way back to a barn. This was no ordinary barn with pigs and chickens; this barn was filled with things made from glass. Shelves were lined with brightly colored bowls, vases, and animal shapes. Dad said that we were there to blow some glass with Nick Labino.

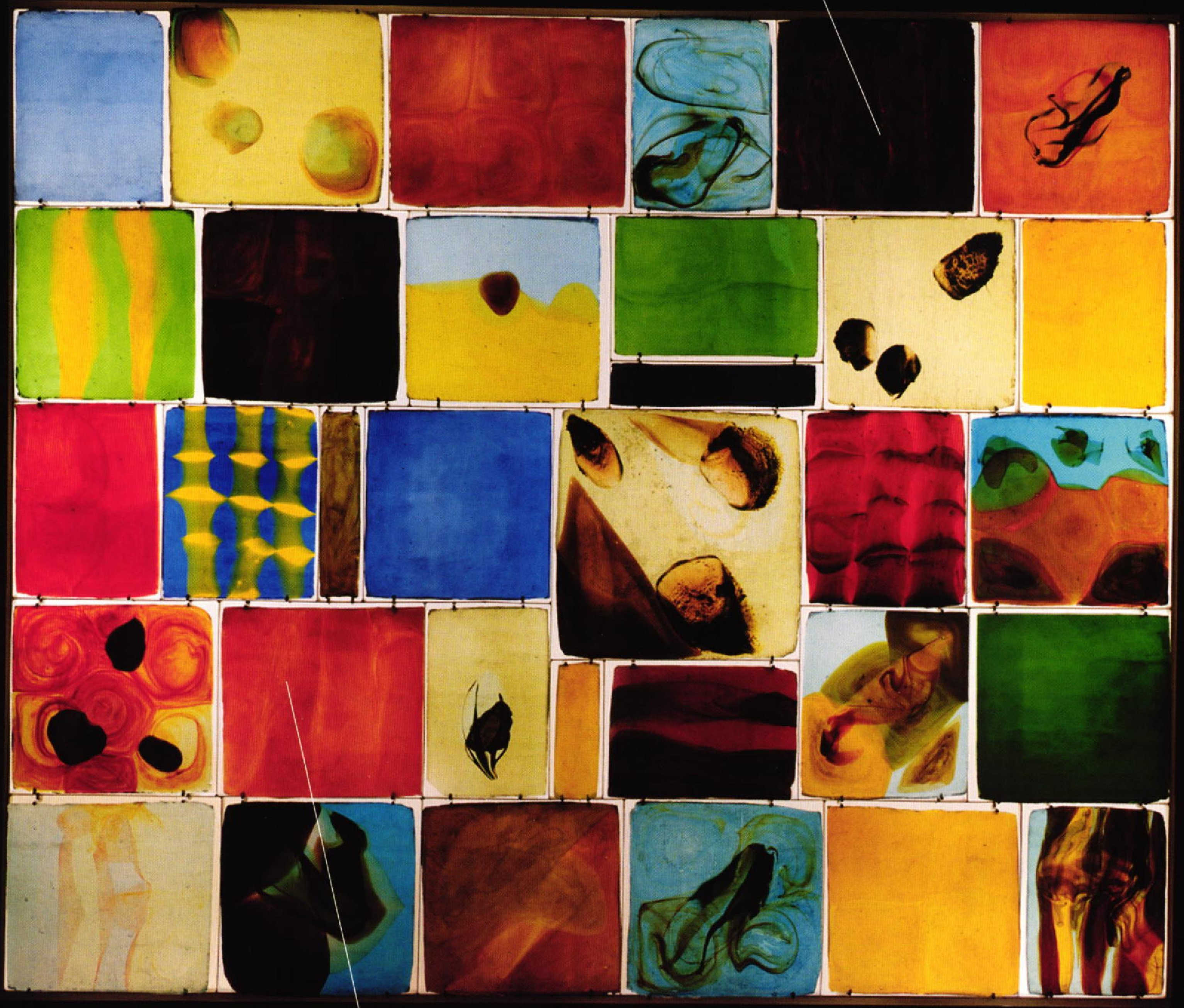
I had a million questions about glass blowing but Dad told me to be quiet and have a seat. He opened the door to the furnace, and I felt a blast of air so hot, it felt like I was in an oven. I watched as my father grabbed a pole called a punty and spun it around so the glass wouldn't fall off. Then he rolled the glass on a table. Dad kept going back to the furnace to reheat the glass. In the meantime, Nick had taken pieces of colored glass and laid them out on the table. I watched my father roll his molten glass into the glass pieces and then use some tools to shape the glass into a round object. Finally he popped the glass off the pole and onto a towel. The glass looked red and orange the entire time my father was working on it, but as it cooled it turned blue. Nick put the glass in a special oven to let it cool gradually, so it wouldn't crack.

WHAT'S THE CONNECTION?

Before Dominick Labino was an artist, he was a scientist. Because of his background and a new interest in creating art, he challenged himself to find just the right formula for glass that would remain pliable long enough to form into different shapes.

Dad told me the glass objects on the shelves were experiments in art. Nick was a scientist and an artist. Nick handed me a glass paperweight that looked like it had a flower inside. "Tell Mr. Labino thank you," my father reminded, and I did.

Q1 How might Labino have created the different designs on each of these panels?



Q2 The space Labino was given to create this mural measured 9' by 8'. What challenges might he have faced in the creation of these 33 irregular panels?

What may have influenced his choices for design?

Dominick Labino, 1910 – 1987
Vitrana, 1969
Mural Composed of 33
Cast Glass Panels Supported
by a Steel Framework
TMA 1970.449

WHAT'S THE HISTORY

Beginning in 1962, Dominick Labino created breakthrough works of art in glass on the grounds of the Toledo Museum of Art. As an artist he was commissioned by the Museum to construct Vitrana, a mural of hot-cast panels with freehand molten inlay. The work of art has continued to be on display since 1970.

1910 • Dominick Labino born in Grand Rapids, Ohio.

1942 • Artist Harvey Littleton creates a torso from glass.

1940s and 1950s • Working as an artist, Labino becomes a painter and sculptor.

1949 • Harvey Littleton is hired by the Toledo Museum of Art to teach art. He develops a strong rapport with TMA Director Otto Wittmann.

1962 • Harvey Littleton, then a professor, and Dominick Labino, a research scientist, conduct a glass workshop on the grounds of TMA with the support of director Otto Wittmann.

1963 • Labino opens a glass studio on his farm in Grand Rapids, Ohio.

1965 • Labino retires from the Johns-Manville Fiber Glass Corporation and begins experimenting with glass full time. As a scientist, Labino held 60 patents in the United States and hundreds in other countries.

1971 • Dale Chihuly, a student of Littleton's, co-founds the legendary Pilchuck Glass School in Stanwood, Washington.

1970s - 1980s • Art glass explodes in popularity with programs created all over the country.

Q1 ANSWER

The panels are hot cast; when the glass was in its liquid state, the designs were made by freehand application of molten glass at the time of casting.

Q2 ANSWER

Making irregular shaped panels to fit an exact space and fitting the panels together. He also had to make choices about color and lighting.

Using the materials in the *Exploring the Glass City: A Teacher's Guide to the Glass Pavilion* will fulfill the Ohio Academic Content Standards listed below:

ANCIENT EGYPT CONTENT STANDARDS ALIGNMENT

VISUAL ARTS
HISTORICAL, CULTURAL AND SOCIAL CONTEXTS

Grade Six
5. Research the role of visual art in selected periods of history using a variety of primary and secondary sources (e.g., print, electronic media, and interviews with a museum curator).

Grade Seven
5. Select and organize artworks from the same historical period and analyze the relationships between the works.

Grade Eight
6. Relate major works of art throughout time to the appropriate historical art movement.

CREATIVE EXPRESSION AND COMMUNICATION

Grade Five
2. Explore different approaches to creating art (e.g., by artist, style, or historical period).

Grade Six
2. Recognize and demonstrate the qualities and characteristics of craftsmanship in original works of art.

Grade Seven
2. Apply the principles of design to construct a three-dimensional piece of artwork.

Grade Eight
1. Identify and apply criteria to assess content and craftsmanship in their works.

SOCIAL STUDIES

History: Early Civilizations

Grade Seven
2. Describe the enduring impact of early civilizations in India, China, Egypt, Greece, and Rome after 1000 b.c., including:
b. Scientific and cultural advancements;
d. Slavery and systems of labor.

History: Thinking and Organizing

Grade Four
4. Describe how archaeologists and historians study and interpret the past.

SCIENCE

Nature of Matter

Grade Four
1. Identify characteristics of a simple physical change (e.g., heating or cooling can change water from one state to another, and the change is reversible).

2. Identify characteristics of a simple chemical change. When a new material is made by combining two or more materials, it has chemical properties that are different from the original materials (e.g., burning paper, vinegar and baking soda).

3. Describe objects by the properties of the materials from which they are made and that these properties can be used to separate or sort a group of objects (e.g., paper, glass, plastic, and metal).

4. Explain that matter has different states (e.g., solid, liquid, and gas) and that each state has distinct physical properties.

Grade Six
2. Describe that in a chemical change new substances are formed with different properties than the original substance (e.g., rusting, burning).

3. Describe that in a physical change (e.g., state, shape, and size) the chemical properties of a substance remain unchanged.

NATURE OF ENERGY

Grade Four
5. Compare ways the temperature of an object can be changed (e.g., rubbing, heating, and bending of metal).

Grade Five
5. Explore and summarize observations of the transmission, bending (refraction), and reflection of light.

MEDIEVAL GLASS CONTENT STANDARDS ALIGNMENT

HISTORY

Grade Three
1. Define and measure time by years, decades, and centuries.

Grade Five
1. Create time lines and identify possible relationships between events.

Grade Six
1. Construct a multiple-tier time line from a list of events and interpret the relationship between the events.

Grade Seven
1. Group events by broadly defined historical eras and enter onto multiple-tier time lines.

5. Describe the impact of new ideas and institutions on European life including:
    b. Major achievements in art, architecture, and literature during the Renaissance.

Grade Eight
1. Select events and construct a multiple-tier time line to show relationships among events.

ECONOMICS

Grade Four

1. Identify the productive resources needed to produce a good or service, and suggest opportunity costs for the resources involved.

SCIENCE
PHYSICAL SCIENCE

Grade Four
1. Identify characteristics of simple physical change.

3. Describe objects by the properties of the materials from which they are made and that these properties can be used to separate or sort a group of objects (e.g., paper, glass, plastic, and metal).

4. Explain that matter has different states and that each state has distinct physical properties.

5. Compare ways the temperature of an object can be changed.

Grade Six
3. Explain that in physical change the chemical properties of a substance remain unchanged.

Grade Seven
1. Investigate how matter can change forms, but the total amount of matter remains constant.

SCIENCE AND TECHNOLOGY

Grade Four
2. Record the results and data from an investigation and make a reasonable explanation.

SKILLS AND METHODS

Grade Six
1.Use multiple sources to define essential vocabulary and obtain information for a research project including: Almanacs, Gazetteers, Trade Books, Periodicals, Video Tapes, Electronic sources.

5. Complete a research project that includes a bibliography.

SCIENTIFIC INQUIRY

Grade Three
5. Record and organize observations (e.g., journals, charts, and tables).

6. Communicate scientific findings to others through a variety of methods (e.g., pictures, written, oral, and recorded observations).

Grade Four
3. Develop, design, and conduct safe, simple investigations or experiments to answer questions.

Grade Five
3. Use evidence and observations to explain and communicate the results of investigations.

VISUAL ARTS

Grade Three
2. Identify and compare similar themes, subject matter, and images in artworks from historical and contemporary eras.

Grade Five
1. Identify visual forms of expression found in different cultures.

4. Demonstrate the way art materials are used by artists to create different styles (e.g., paint applied spontaneously in expressionism and more carefully in minimalism).

5. Examine how social, environmental, or political issues affect design choices.

6. Explain how art galleries, museums and public art contribute to the documentation and preservation of art history.

Grade Six
1. Compare and contrast visual forms of expression found throughout different regions and cultures of the world.

2. Identify universal themes conveyed in artworks across various times and cultures.

5. Research the role of visual art in selected periods of history using a variety of primary and secondary sources.

Grade Seven
1. Use multiple sources to research various art forms used for social, cultural, or political purposes.

5. Select and organize artworks from the same historical period, and analyze the relationship between works.

Grade Eight
1. Explain how social, cultural, and political factors affect what artists, architects, or designers create.

2. Discuss the role and function of art objects within cultures.

6. Relate major works of art throughout time to the appropriate historical art movement.

RENAISSANCE/VENICE CONTENT STANDARDS ALIGNMENT

SOCIAL STUDIES

History: Feudalism and Traditions

Grade Seven
4. Explain the lasting effects of military conquests during the Middle Ages including:
a. Muslim conquests;
b. The Crusades;
c. The Mongol invasions.

5. Describe the impact of new ideas and institutions on European life including:
a. The significance of printing with movable type;
b. Major achievements in art, architecture, and literature during the Renaissance;
c. The Reformation.

HISTORY: THE FIRST GLOBAL AGE

Grade Seven
7. Describe the causes and effects of European exploration after 1400, including: a. Imperialism, colonialism, and mercantilism.

ECONOMICS: MARKETS

Grade Six
4. Identify goods and services that are imported and exported and explain how this trade makes countries interdependent.

5. Describe how supply and demand help to set the market clearing price for goods and services and how prices reflect the relative scarcity of goods and services.

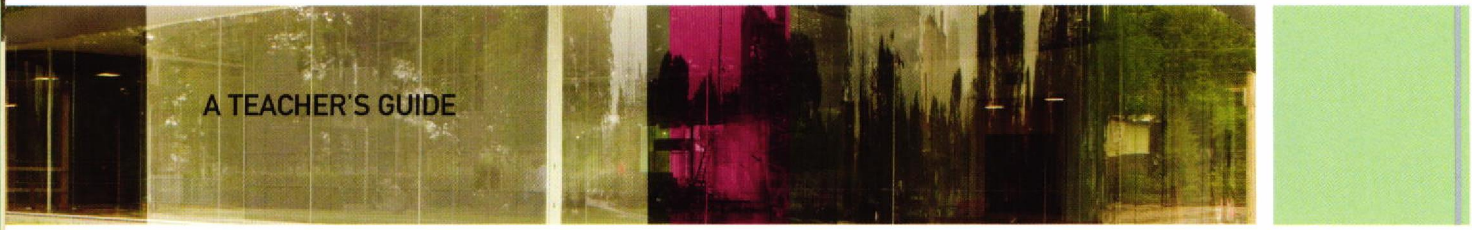
Grade Seven
2. Describe the growth of cities and the establishment of trade routes in Asia, Africa, and Europe; the products and inventions that traveled along these routes (e.g., spices, textiles, paper, precious metals, and new crops); and the role of merchants.

ECONOMICS: SCARCITY AND RESOURCE ALLOCATION

Grade Six
1. Explain how the availability of productive resources and entrepreneurship affects the production of goods and services in different world regions.

2. Explain that most decisions involve trade-offs and give examples.

Grade Seven
1. Compare the endowment of productive resources in world regions, and explain how this endowment contributed to specialization, trade, and interdependence in ancient times.



SKILLS AND METHODS: THINKING AND ORGANIZING

Grade Seven

1. Describe historical events and issues from the perspectives of people living at the time in order to avoid evaluating the past in terms of today's norms and values.

GEOGRAPHY: MOVEMENT

Grade Seven

5. Describe the geographic factors and processes that contribute to and impede the diffusion of people, products, and ideas from place to place including:
a. Physical features;
b. Culture;
c. War;
d. Trade;
e. Technological innovations.

LIBBEY AND INDUSTRIAL GLASS OHIO STANDARDS ALIGNMENT

SOCIAL STUDIES
HISTORY

Grade Three

3. Describe changes in the community over time, including changes in:
a. Businesses;
b. Architecture;
c. Physical features;
d. Employment;
e. Education;
f. Transportation;
g. Technology;
h. Religion;
i. Recreation.

Grade Four

6. Explain the importance of inventors such as the Wright Brothers, Charles Kettering, Garrett Morgan, Granville Woods, and Thomas Edison.

Grade Five

6. Explain the impact of settlement, industrialization, and transportation on the expansion of the United States.

GEOGRAPHY

Grade Three

1. Use political maps, physical maps, and aerial photographs to ask and answer questions about the local community.

6. Identify and describe the landforms and climate, vegetation, population, and economic characteristics of the local community.

7. Identify ways that physical characteristics of the environment (i.e., landforms, bodies of water, climate, and vegetation) affect and have been modified by the local community.

Grade Four

4. Use maps to identify the location of major physical and human features of Ohio, including:
a. Lake Erie;
b. Rivers;
c. Plains;
d. The Appalachian Plateau;
e. Bordering states;
f. The capital city;
g. Other major cities.

5. Describe and compare the landforms, climates, population, vegetation, and economic characteristics of places and regions in Ohio.

6. Identify manufacturing, agricultural, mining, and forestry regions in Ohio.

7. Explain how resources, transportation, and location influenced the development of cities and industries in Ohio including major industries such as oil, steel, rubber, and glass.

9. Identify ways that people have affected the physical environment of Ohio, including:
a) Use of wetlands;
b) Use of forests;
c) Building farms, towns, and transportation systems;
d) Using fertilizers, herbicides, and pesticides;
e) Building dams.

10. Use elevation, natural resource, and road maps to answer questions about patterns of settlement, economic activity, and movement.

Grade Five

5. Explain, by identifying patterns on thematic maps, how physical and human characteristics can be used to define regions in North America.

6. Use distribution maps to describe the patterns of renewable, nonrenewable, and flow resources in North America including:
a. Forests;
b. Fertile soil;
c. Oil;
d. Coal;
e. Running water.

8. Explain how the characteristics of different physical environments affect human activities in North America.

Grade Six

3. Explain the distribution patterns of economic activities and how changes in technology, transportation, communication, and resources affect those patterns, including:
a. Agriculture;
b. Mining;
c. Fishing;
d. Manufacturing.

5. Describe ways human settlements and activities are influenced by environmental factors and processes in different places and regions, including:
a. Bodies of water;
b. Landforms;
c. Climates;
d. Vegetation;
e. Weathering;
f. Seismic activity.

7. Describe ways humans depend on and modify the environment and the positive and negative consequences of the modifications, including:
a. Dam building;
b. Energy production/usage;
c. Agriculture;
d. Urban growth.

8. Explain push and pull factors that cause people to migrate from place to place, including:
a. Oppression/Freedom;
b. Poverty/Economic opportunity;
c. Cultural ties;
d. Political conflicts;
e. Environmental factors.

Grade Seven
1. For each of the societies studied, identify the location of significant physical and human characteristics on a map of the relevant region.

2. On a map, identify places related to the historical events being studied and explain their significance.

3. Describe changes in the physical and human characteristics of regions that occur over time and identify the consequences of such changes.

5. Describe the geographic factors and processes that contribute to and impede the diffusion of people, products, and ideas from place to place, including:
a. Physical features;
b. Culture;
c. War;
d. Trade;
e. Technological innovations.

Grade Eight
2. Analyze how physical characteristics of the environment influenced population distribution, settlement patterns, and economic activities in the United States during the 18th and 19th centuries.

3. Explain how colonization, westward expansion, immigration, and advances in transportation and communication changed geographic patterns in the United States.

ECONOMICS

Grade Six
1. Explain how the availability of productive resources and entrepreneurship affects the production of goods and services in different world regions.

3. Explain why trade occurs when individuals, regions, and countries specialize in what they can produce at the lowest opportunity cost and how this causes both production and consumption to increase.

SOCIAL STUDIES SKILLS AND METHODS

Grade Three
1. Obtain information about local issues from a variety of sources, including:
a. Maps;
b. Photos;
c. Oral histories;
d. Newspapers;
e. Letters;
f. Artifacts;
g. Documents.

6. Use a problem-solving/decision-making process, which includes:
a. Identifying a problem;
b. Gathering information;
c. Listing and considering options;
d. Considering advantages and disadvantages of options;
e. Choosing and implementing a solution.

Grade Four
1. Obtain information about state issues from a variety of print and electronic sources, and determine the relevance of information to a research topic:
a. Atlases;
b. Encyclopedias;
c. Dictionaries;
d. Newspapers;
e. Multimedia/Electronic sources.

2. Use a glossary and index to locate information.

3. Use primary and secondary sources to answer questions about Ohio history.

4. Describe how archaeologists and historians study and interpret the past.

Grade Five
1. Obtain information from a variety of print and electronic sources and analyze its reliability, including:
a. Accuracy of facts;
b. Credentials of the source.

9. Use a problem-solving/decision-making process, which includes:
a. Identifying a problem.

Grade Six
1.Use multiple sources to define essential vocabulary and obtain information for a research project including:
a. Almanacs;
b. Gazetteers;
c. Trade books;
d. Periodicals;
e. Video tapes;
f. Electronic sources.

Grade Seven
1. Describe historical events and issues from the perspectives of people living at the time in order to avoid evaluating the past in terms of today's norms and values.

SCIENCE
PHYSICAL SCIENCE

Grade Four
1. Identify characteristics of a simple physical change (e.g., heating or cooling can change water from one state to another and the change is reversible).

2. Identify characteristics of a simple chemical change. When a new material is made by combining two or more materials, it has chemical properties that are different from the original materials (e.g., burning paper, vinegar and baking soda).

3. Describe objects by the properties of the materials from which they are made and that these properties can be used to separate or sort a group of objects (e.g., paper, glass, plastic, and metal).

4. Explain that matter has different states (e.g., solid, liquid, and gas) and that each state has distinct physical properties.

SCIENTIFIC INQUIRY

Grade Three
1. Select the appropriate tools and use relevant safety procedures to measure and record length and weight in metric and English units.

2. Discuss observations and measurements made by other people.

3. Read and interpret simple tables and graphs produced by self/others.

5. Record and organize observations (e.g., journals, charts, and tables).

6. Communicate scientific findings to others through a variety of methods (e.g., pictures, written, oral and recorded observations).

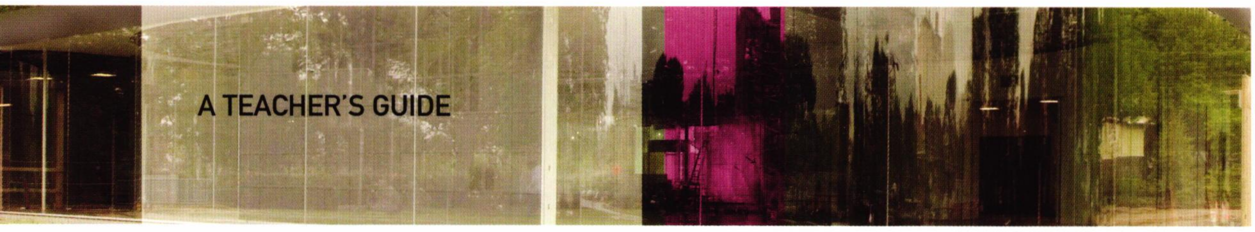
Grade Four
3. Develop, design, and conduct safe, simple investigations or experiments to answer questions.

6. Formulate instructions and communicate data in a manner that allows others to understand and repeat an investigation or experiment.

Grade Five
2. Evaluate observations and measurements made by other people and identify reasons for any discrepancies.

3. Use evidence and observations to explain and communicate the results of investigations.

Grade Six
4. Explain that a single example can never prove that something is always correct, but sometimes a single example can disprove something.



Grade Seven
5. Analyze alternative scientific explanations and predictions and recognize that there may be more than one good way to interpret a given set of data.

6. Identify faulty reasoning and statements that go beyond the evidence or misinterpret the evidence.

VISUAL ARTS

Grades Three
2. Identify and compare similar themes, subject matter, and images in artworks from historical and contemporary eras.

4. Recognize selected artists who contributed to the cultural heritages of the people of the United States.

Grade Four
4. Select an Ohio artist and explain how the artist's work relates to Ohio history.

Grade Five
4. Demonstrate the way art materials are used by artists to create different styles (e.g., paint applied spontaneously in expressionism and more carefully in minimalism).

6. Explain how art galleries, museums, and public art contribute to the documentation and preservation of art history.

7. Describe the lives, works, and impact of key visual artists in a selected period of United States History.

Grade Six
5. Research the role of visual art in selected periods of history using a variety of primary and secondary sources (e.g., print, electronic media, and interviews with a museum curator).

Grade Seven
5. Select and organize artworks from the same historical period and analyze the relationships between the works.

Grade Eight
6. Relate major works of art throughout time to the appropriate historical art movement.

STUDIO GLASS MOVEMENT CONTENT STANDARDS ALIGNMENT

SOCIAL STUDIES
HISTORY

Grade Four
6. Explain the importance of inventors such as the Wright Brothers, Charles Kettering, Garrett Morgan, Granville Woods, and Thomas Edison.

SCIENCE
PHYSICAL SCIENCE

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3. Describe objects by the properties of the materials from which they are made and that these properties can be used to separate or sort a group of objects (e.g., paper, glass, plastic, and metal).

4. Explain that matter has different states (e.g., solid, liquid, and gas) and that each state has distinct physical properties.

SCIENTIFIC INQUIRY

Grade Four
1. Select the appropriate tools and use relevant safety procedures to measure and record length and weight in metric and English units.

3. Develop, design, and conduct safe, simple investigations or experiments to answer questions.

Grade Five
1. Select and safely use appropriate tools to collect data when conducting investigations and communicating findings to others.

2. Evaluate observations and measurements made by other people and identify reasons for any discrepancies.

3. Use evidence and observations to explain and communicate the results of investigations.

6. Explain why results of an experiment are sometimes different.

Grade Six
2. Choose the appropriate tools and instruments, and use relevant safety procedures to conduct scientific investigations.

Grade Seven
4. Choose the appropriate tools and instruments, and use relevant safety procedures to conduct scientific investigations.

Grade Eight
1. Choose the appropriate tools and instruments and use relevant safety procedures to conduct scientific investigations.

SCIENTIFIC WAYS OF KNOWING

Grade Six
4. Describe how the pursuit of scientific knowledge is beneficial for any career and for daily life.

5. Research how men and women of all countries and cultures have contributed to the development of science.

VISUAL ARTS
HISTORICAL, CULTURAL AND SOCIAL CONTEXTS

Grade Four
4. Select an Ohio artist and explain how the artist's work relates to Ohio history.

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Toledo Museum of Art
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DATE DUE

This project was funded
by the generous
support of the
Martha Holden Jennings
Foundation.

Toledo Museum of Art
P.O. Box 1013
Toledo, Ohio 43697-1013

Hours

Tuesday-Saturday 10A.M. - 4P.M.
Friday 10A.M. - 10P.M.
Sunday 11A.M. - 5P.M.
Closed Monday

Admission

Free to all thanks in part to the support of Museum members.
There is a charge for select ticketed exhibitions.

Directions

Just off I-75 near Downtown Toledo
Take either the Collingwood or Detroit Avenue exits,
then follow the signs.

Information

419.255.8000
www.toledomuseum.org

Our Mission

We believe in the power of art to ignite the imagination, stimulate thought, and provide enjoyment. Through our collection and programs, we strive to integrate art into the lives of people.